Circuitry for compensating for the effect of light on the operation of infrared-sensitive phototransistors in a contact display panel

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- US4855590
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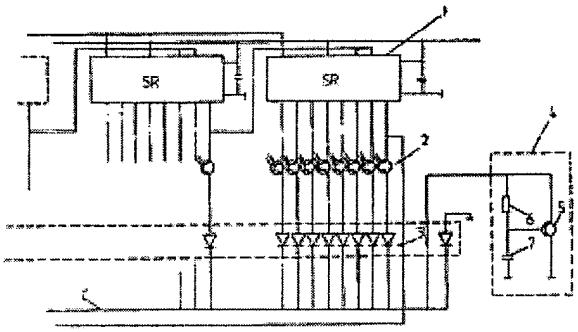
Abstract of **EP0426469**

The invention relates to a circuitry for compensating the effect of external light on infrared-sensitive phototransistors (2) in a contact display panel, the phototransistors being coupled via diodes (3) to a common line (c). The compensation circuitry is a voltage-dependent resistor (4) between the common line (c) and the ground of the circuit, the resistance value of the resistor decreasing as the direct-voltage level of the line (c) rises. The resistor (4) is preferably a transistor circuit.



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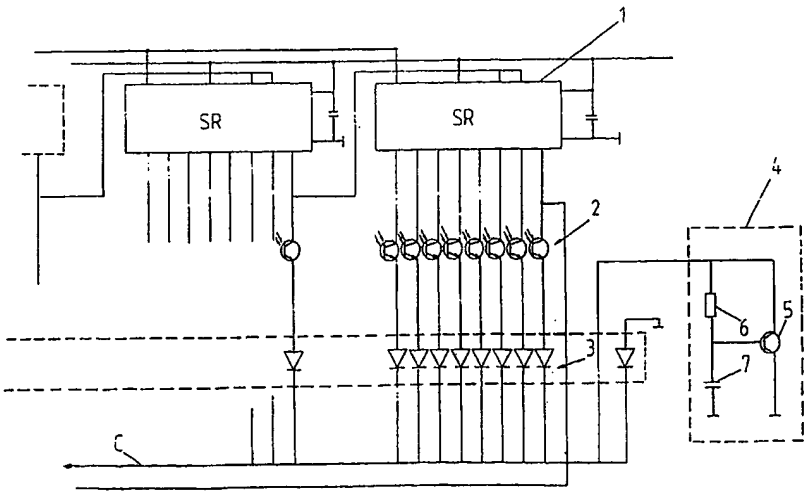
(54) Circuitry for compensating for the effect of light on the operation of infrared-sensitive phototransistors in a contact display panel.

(57) The invention relates to a circuitry for compensating the effect of external light on infrared-sensitive phototransistors (2) in a contact display panel, the phototransistors being coupled via diodes (3) to a common line (c). The compensation circuitry is a voltage-dependent resistor (4) between the common line (c) and the ground of the circuit, the resistance value of the resistor decreasing as the direct-voltage level of the line (c) rises. The resistor (4) is preferably a transistor circuit.



EP 0 426 469 A2

CIRCUITRY FOR COMPENSATING FOR THE EFFECT OF LIGHT ON THE OPERATION OF INFRARED-SENSITIVE PHOTOTRANSISTORS IN A CONTACT DISPLAY PANEL

The invention relates to a circuitry by means of which it is possible to compensate for the effect of external light on phototransistors used in a contact display panel.

A contact display panel circuitry comprises one or several transfer registers having a series-form input and a parallel-form output. A phototransistor and a diode emitting infrared light are coupled to each of the parallel outputs. According to Patent Application FI-895242, there may be coupled in series with a phototransistor a diode by means of which the transistor of each output is coupled to a common line. The transfer registers scan the phototransistor-diode pairs of the parallel outputs of the transfer registers, giving to each of them in turn a voltage pulse, and the pulse frequency, i.e. the frequency between the pulsing of the adjacent phototransistors, is approx. 1 kHz. Depending on the component type, the phototransistors are sensitive, for example, within a wavelength range of 700-1100 nm, which is in the main infrared range. The phototransistor and the infrared diode coupled to the output of a transfer register are arranged so that the transistor and the diode are located in alignment on opposite sides of the display. The phototransistors are thus on two adjacent sides of the display and the corresponding infrared diodes are on the sides opposite to them. When a point in the display is touched, the radiation pulses of the diodes transmitting infrared radiation in the vertical and horizontal directions (1 in each direction) at this point cannot reach the corresponding phototransistors, whereupon modulation caused by the infrared beam disappears from the pulse received from their emitter. The logic circuit of the device is capable of determining the location of the contact point (coordinates X, Y) on the basis of the lacking modulation.

Since all of the phototransistors are coupled via the diodes described in said Patent Application FI-895242 to a common line leading to the logic circuit, it is important that the direct-voltage level of this line should remain as stable as possible. However, this is not always the case; phototransistors also react to intense external radiation which is within the wavelength range of light. When external light strikes the components, the collector current of the phototransistors begins to grow, the transistors begin to "open", and as a consequence of this the direct-voltage level of the said line begins to rise. When the DC level has risen to a sufficiently high level, the phototransistors will no longer react to infrared radiation and the contact display will no longer operate in the desired manner. This phenomenon is detrimental, since, when a device equipped with the said panel is used outdoors, for example in automobile use, even sunlight will cause operational disturbance. It has been observed that, for example, even bringing an ordinary desk lamp to a distance of approx. one meter from the phototransistors suffices to raise the DC level of the line to such a level that the transistors no longer react to infrared radiation.

Attempts have been made to solve by mechanical means the problem of disturbances caused by external light to infrared components: attempts have been made to shield the components with various types of casings and with plastic sheets, placed to shield the components, which to some extent filter external light. These mechanical shielding means increase the size of the circuit, which is of course detrimental in small-sized devices, and increase the costs.

The present invention discloses a circuitry by means of which the prior-art mechanical shield structures can be eliminated, is inexpensive, and enables very small-sized infrared compo nents to be used. The invention is characterized in that between the line to which the phototransistors are coupled via diodes and the ground of the circuit there is coupled a voltage-dependent resistor which tends to maintain the DC level of the line constant.

The invention is described in greater detail with reference to the accompanying figure, which depicts the circuitry of a contact display panel.

The circuitry includes a plurality of SI/PO transfer registers 1, each of which has a series-form input and a parallel-form output. The pulse frequency of the transfer registers is ≈ 1 kHz. To the output of each transfer register there is coupled a phototransistor 2, which is further coupled via a diode 3 to the common line c. The most sensitive range of the phototransistors 2 is, for example, approx. 900 nm. The conductivity of any of the phototransistors can be seen from the modulation signal multiplied on the direct-voltage level of the line c, and the cutting off of the infrared beam will cause an absence of modulation. In order that the DC-level of this line should not rise to too high a level, according to the invention there is coupled between this line and the ground a voltage-dependent resistor 4, which is a transistor circuit. The circuit simply comprises a transistor 5, between the base and the ground of which there is a capacitor 7 and between the base and the collector a resistor 5. The emitter is coupled directly to the ground. The time constant RC of the resistor and the capacitor is greater than the said pulse frequency 1

kHz, in order that the base voltage should change sufficiently slowly according to the DC level of the line c. When the DC level of the line c tends to grow, the current passing via the transistor 5 increases and its collector voltage, i.e. the direct voltage of the line c, decreases. Respectively, then the voltage of the line c has decreased to its desired level, the conductivity of the transistor 5 decreases. In this manner the DC level of the line c is simply prevented from rising to so high a level that the operation of the phototransistors would be disturbed.

By using the circuitry disclosed, the disadvantages involved in the prior-art mechanical shielding of infrared components are eliminated in a simple manner. It has been observed experimentally that a desk lamp can be brought to a distance shorter than 0.1 meter the from phototransistors before their operation is disturbed. The improvement is significant, because previously the corresponding distance was approx. one meter. With the circuitry according to the invention, the voltage across the phototransistors will remain sufficiently high, in which case the internal capacitances will remain low and the operating point will remain within a linear range. The circuitry also enables a low supply voltage (5 V) to be used, and leveling out the differences among electronic characteristics, caused by the tolerances of the phototransistors. The circuitry enables inexpensive infrared components without casings to be used, and, owing to the absence of casings, it is possible to use small-size components.

The voltage-dependent resistor used may also be a phototransistor instead of a bipolar transistor. The phototransistor must in this case be such that it works linearly even if an external source of light is intense and if the phototransistor has to be placed mechanically in such a place that it will detect maximally the intensity of external light.

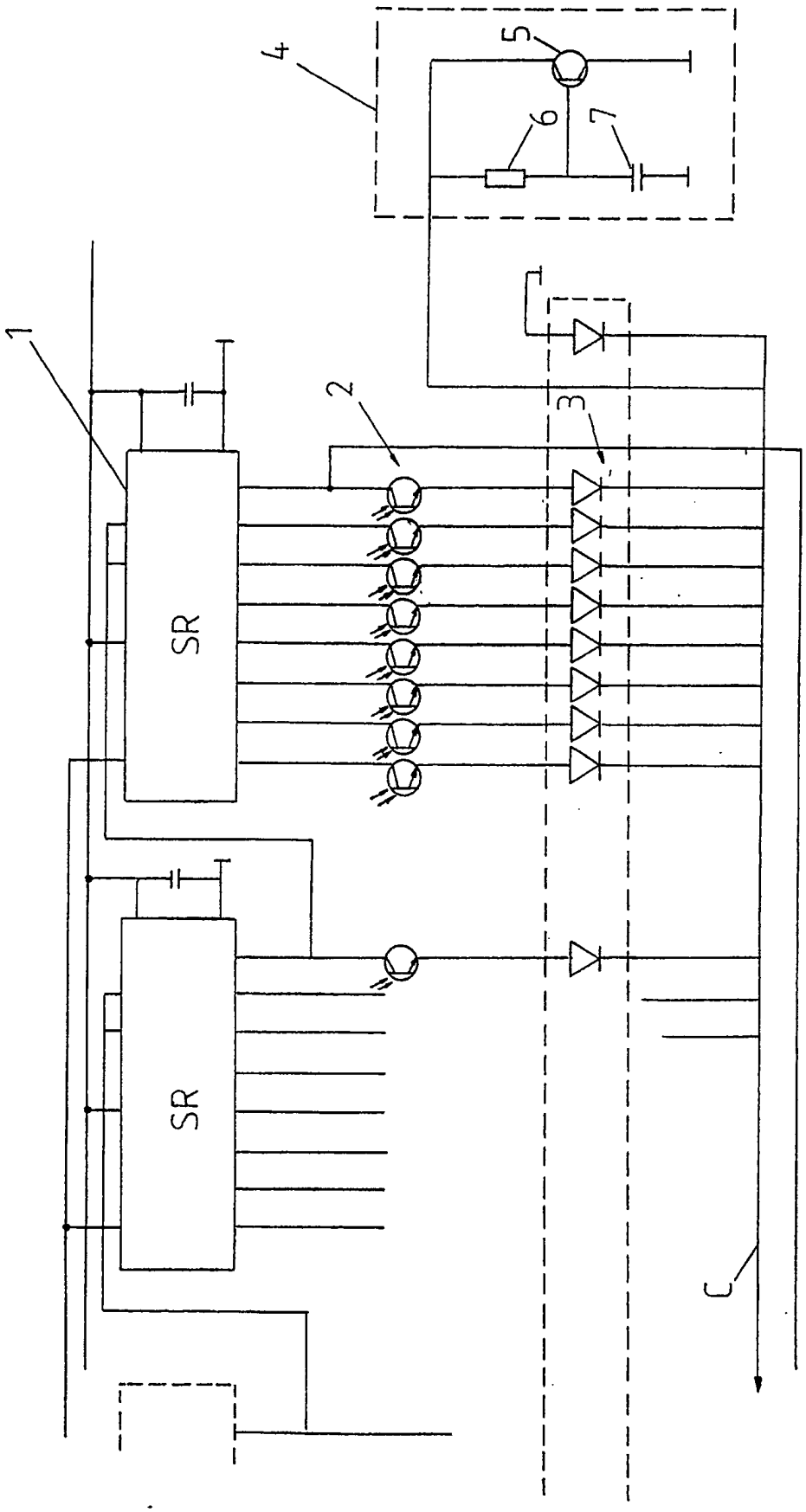
Claims

1. An electronic circuitry which compensates for the effect of external light by means of at least one SI/PO transfer register (1) on the operation of infrared-sensitive phototransistors pulsed (2) at a frequency (f), the phototransistors being coupled to a common line (c) via a diode (3), **characterized** in that the circuitry is a voltage-dependent resistor (4) between the common line (c) and the ground of the circuit, its resistance value decreasing as the direct-voltage level of the line (c) decreases.

2. A circuitry according to Claim 1, **characterized** in that the voltage-dependent resistor (4) is a transistor circuit in which the collector of the transistor (5) is coupled to the line (c), the emitter is coupled to the ground of the circuit, and the base is coupled to the ground via a capacitor (7) and to the line (c) via a resistor (6), and the time constant (RC) of the capacitor (7) and the resistor (6) is greater than the length of the cycle of the pulse frequency (f).

3. A circuitry according to Claim 2, **characterized** in that the transistor (5) is a phototransistor which is placed mechanically in such a place that it will detect maximally well the intensity of external light.

4. A circuitry according to Claim 1, **characterized** in that it is used in a contact display panel.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